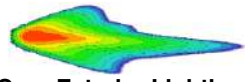

Core Exterior Lighting

Exterior Lighting evolution - need for revolution

DVN Workshop Rochester 2019

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Light for humans – the original need

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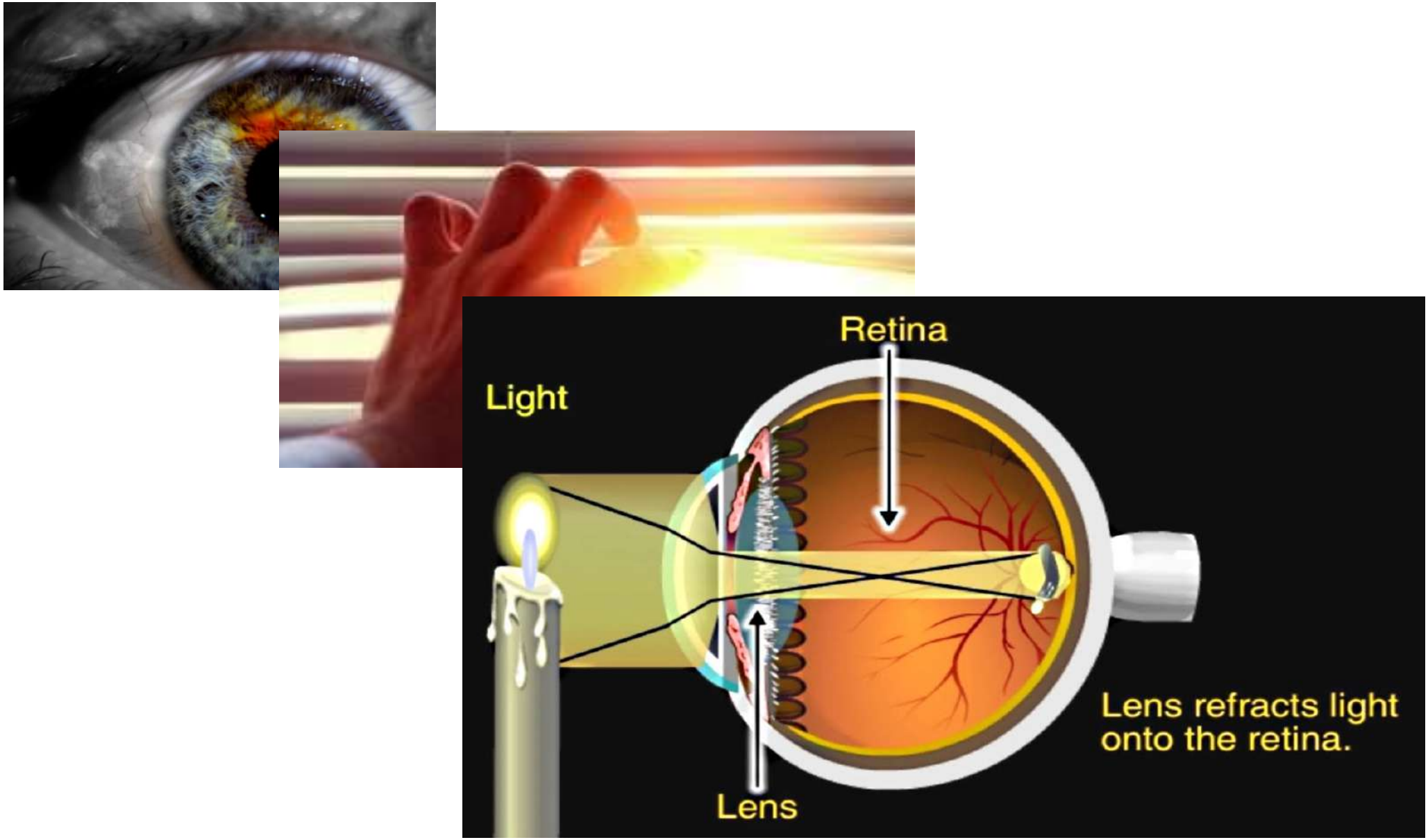
Light for humans – the eye



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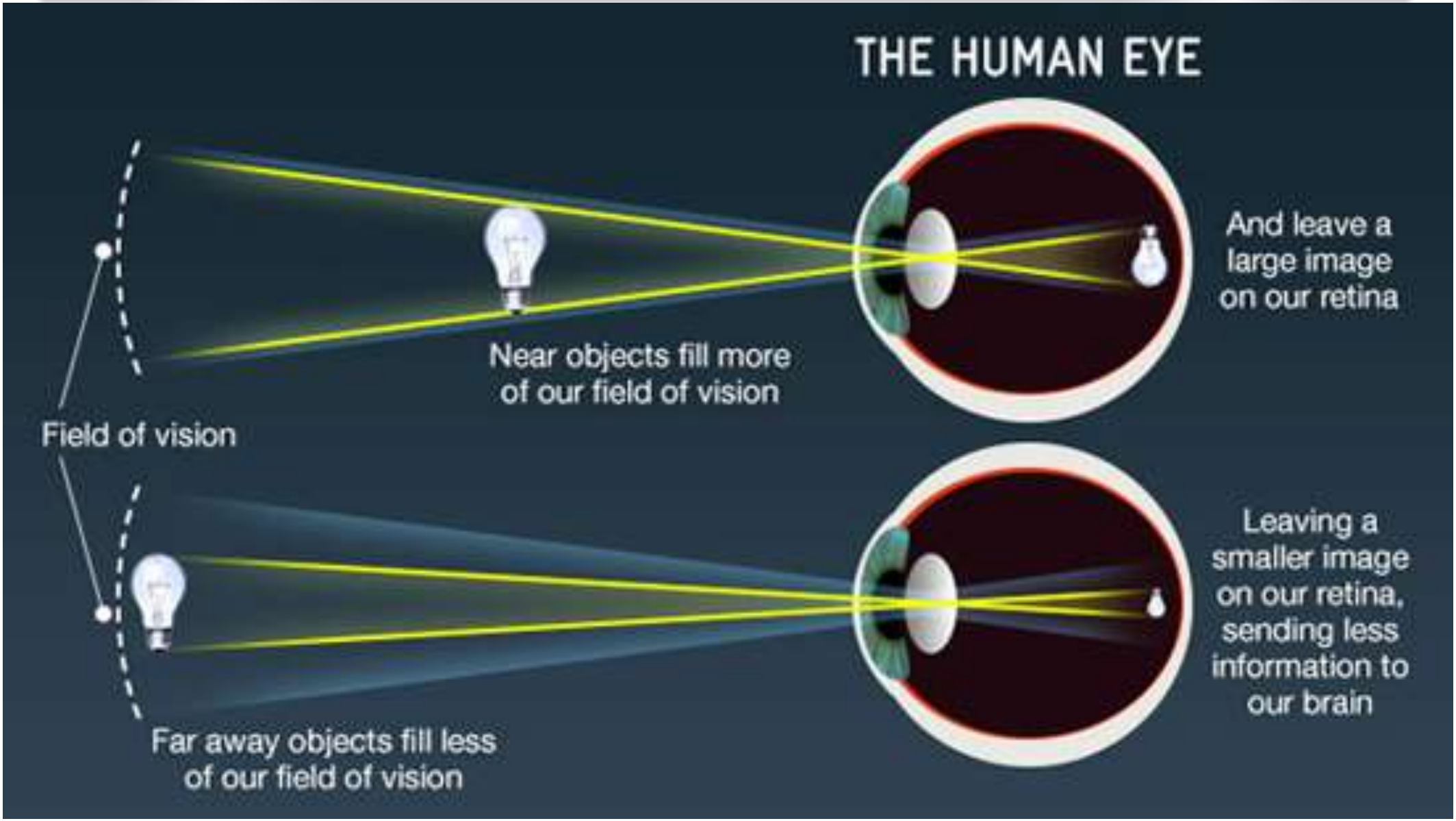
Light for humans – the eye



Source: BBC

More distance requires more light

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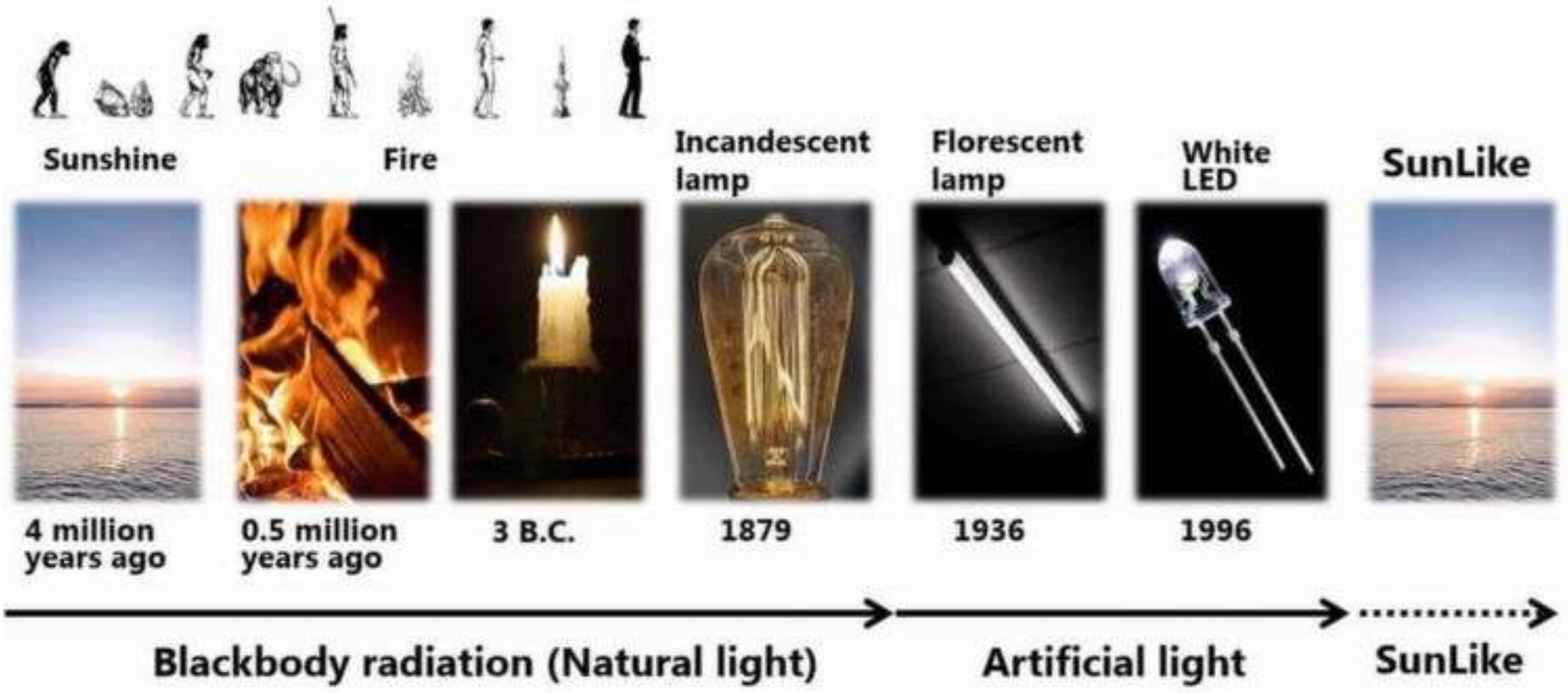
Light source evolution



Source: Elektronikpraxis

1st vehicles

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First cars – 20th centry

1900 - 1935

1901
Trans Atlantic Radio Transmission
Marconi

1903
First Flight
Wright Brothers - USA

1905
SAE Formed
USA

1906
First Grand Prix
France

1911
Standard Oil Co - Broken Up
USA

1912
Titanic Sinks
Harland & Wolff - UK

1912
Peak of Electric Car Sales
USA

1912
Starter Motor
Delco - USA

1914-18
World War 1

1914
Automatic Transmission
Mercedes - Germany

1919
Transatlantic Flight
Alcock & Brown - England

1920
First Commercial Radio Station
WWJ Detroit - USA

1922
First Unibody Car
Lancia - Italy

1927
First Car to Reach 200mph
Sunbeam - UK

1928
First Freeway
Italy

1928
Synchromesh Gears
Cadillac - USA

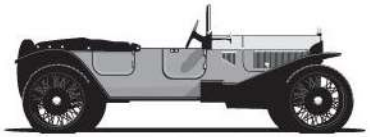
1929
Stockmarket Crash
USA

1930
Art Center Founded
Los Angeles

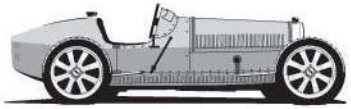
1930
First Car Radio
Galvin Corp - USA

1934
Run Flat Tires
Michelin -France

Ford Model T
1912



Lancia Lambda
1922



Bugatti Type 35
1922

Chrysler Airflow
1934

H-POINT | History

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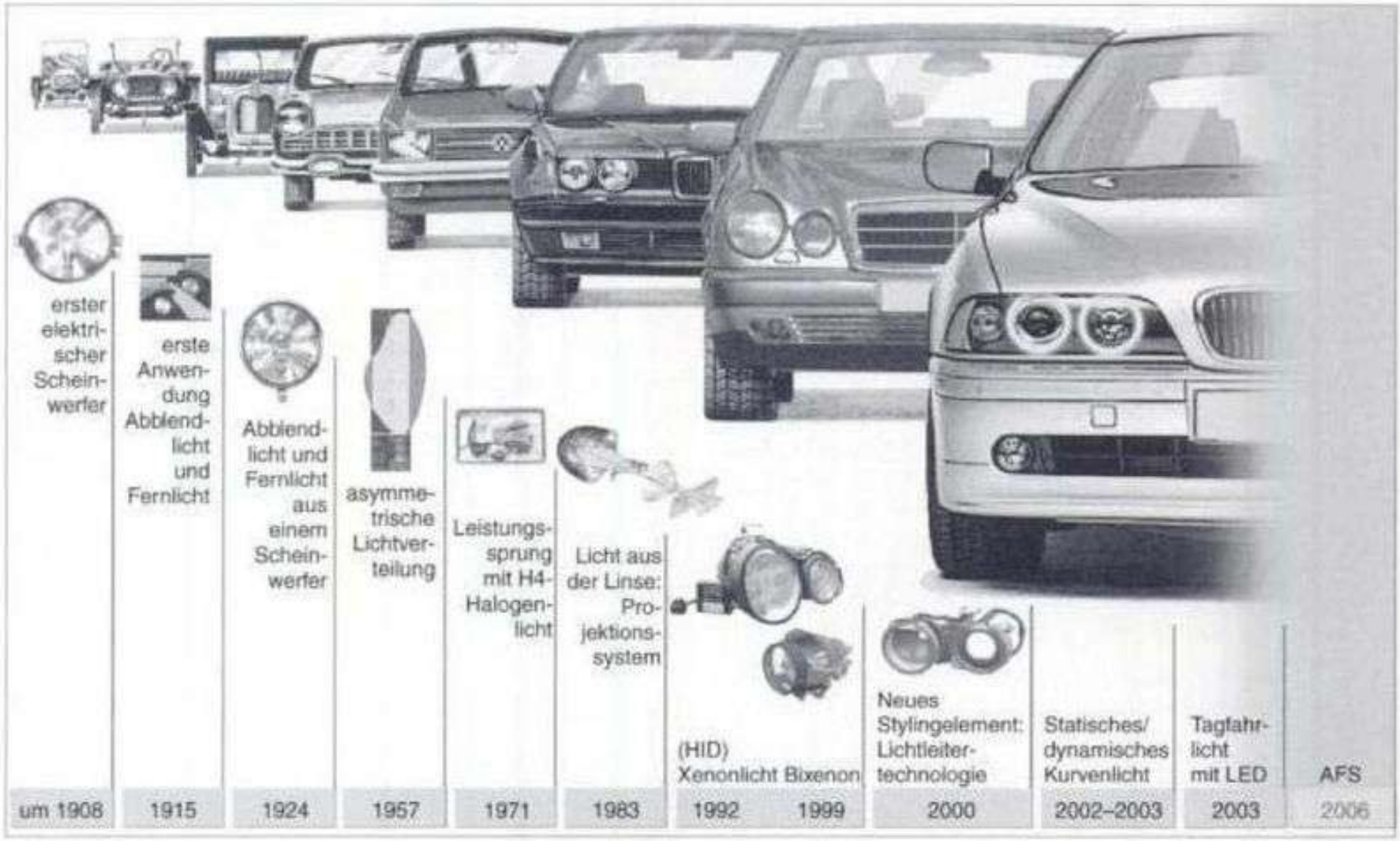
History of automotive light sources



Source: Universtiy of Münster Germany

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At the beginning – Model T

Ford Model T 1920s

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A few decades later – Model T & Mustang

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Light – safety for the driver – more light and brighter

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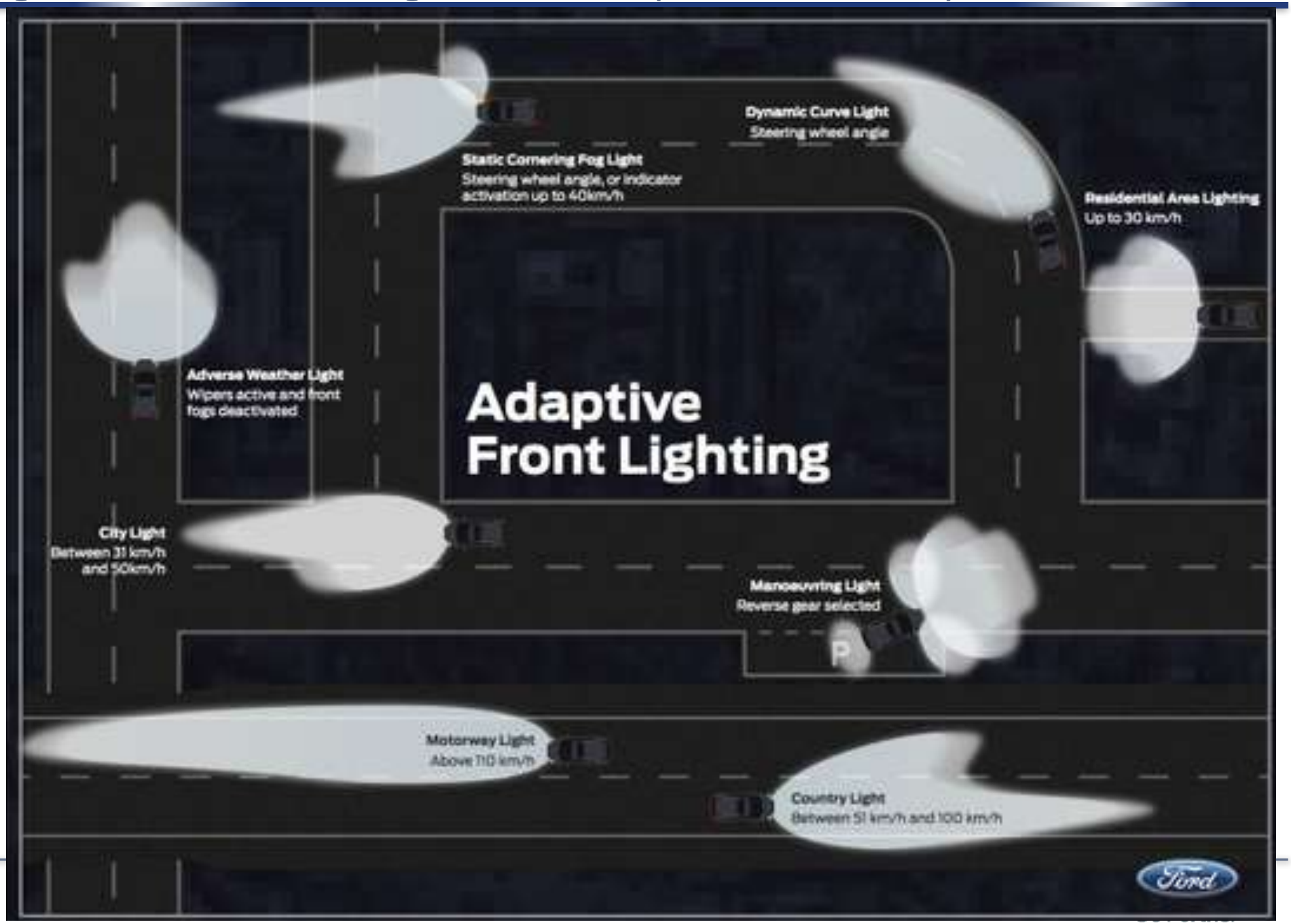
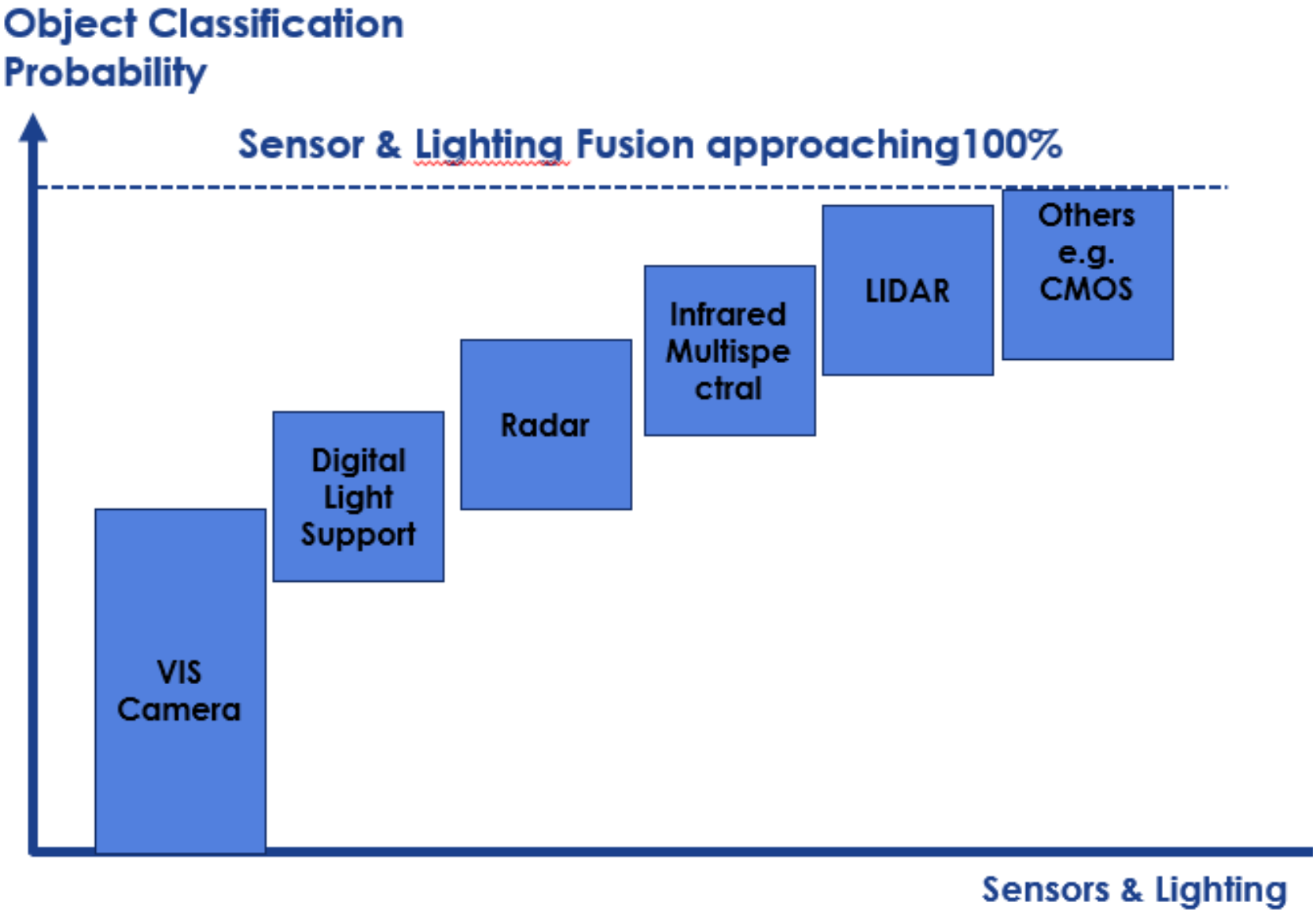
Light for humans– utilizing vehicle data (CAN/LIN connect)



Sensor opportunity



Quelle: DVN Lidar Congress 2018

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Light for humans and Sensors – a symbiosis utilizing cameras

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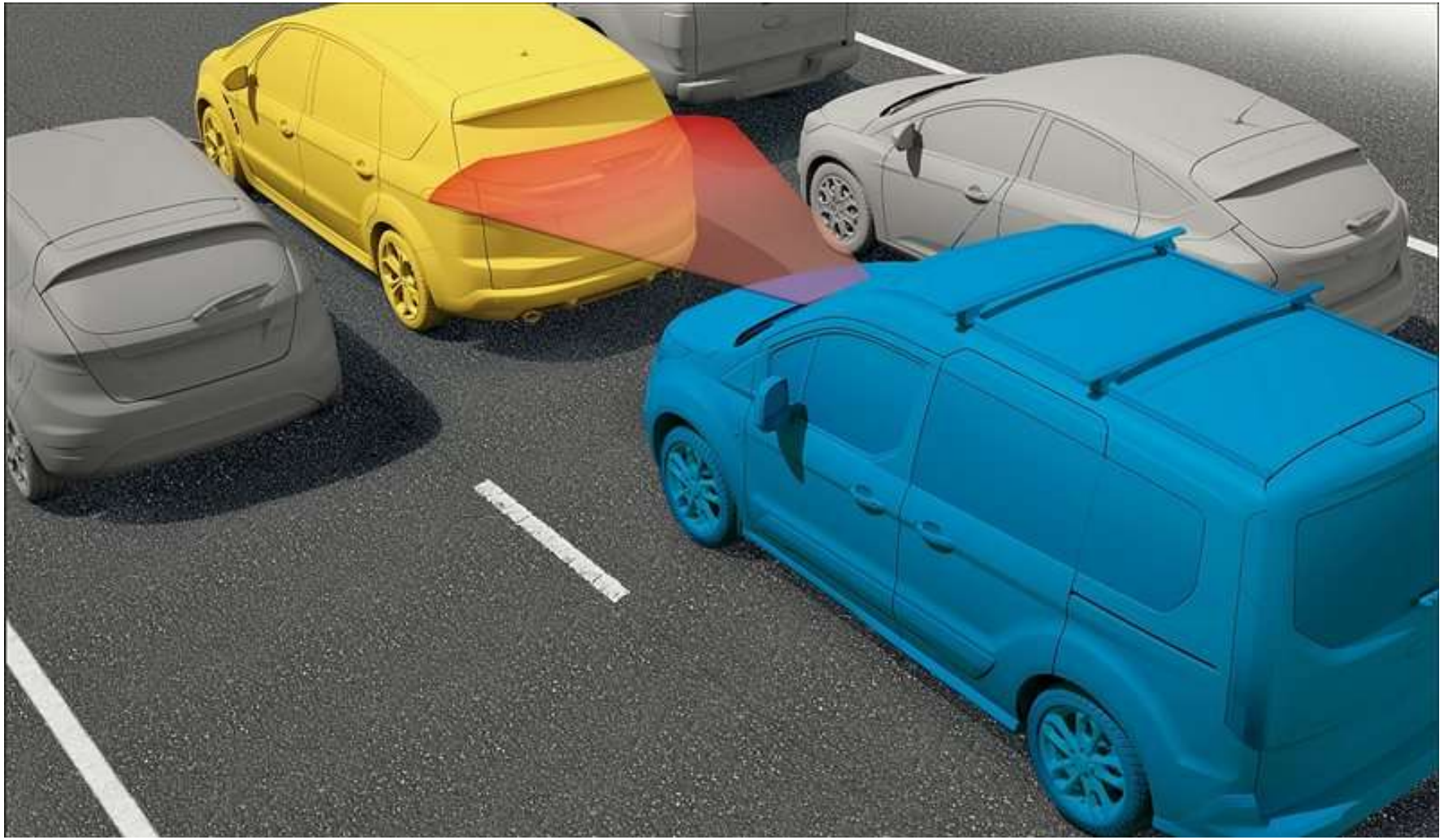
Light for humans and Sensors – a symbiosis



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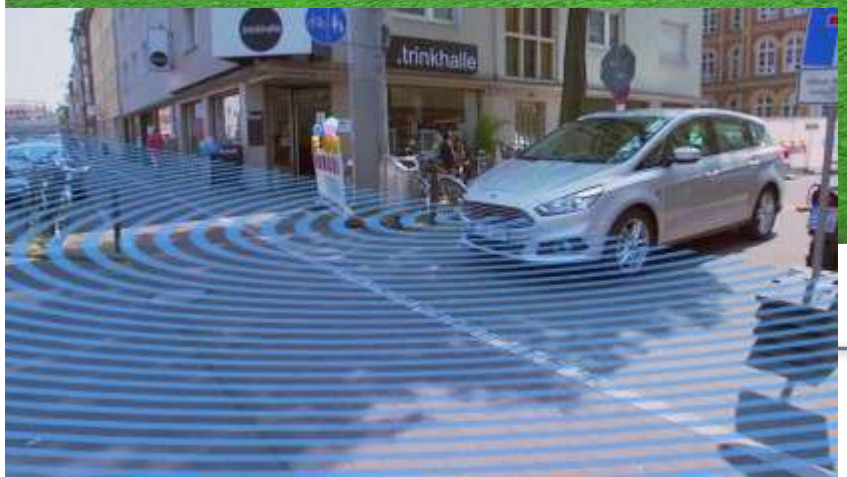
Cameras – helps the driver where needed

Core Exterior Lighting



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Camera– enable ADB functionality and more visibility at night

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LiDAR integration – the beginning at FORD

HISTORY OF AUTONOMY

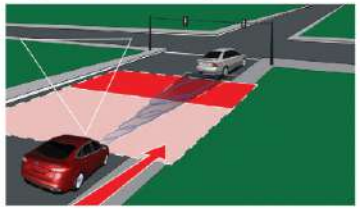
2004 Ford's Jim McBride volunteers at the original DARPA autonomous vehicle challenge, which leads Ford to compete the following year

2005 & 2007 Using a self-driving Ford F-250 Super Duty, Ford is one of only six teams to qualify as a finalist at the DARPA Desert Classic and Urban Finals, supported by engineers still with the company

2006 Ford Motor Company introduces adaptive cruise control

2008 Ford Motor Company debuts driver-assist technology features – Blind Spot Information System, lane-keeping system and active park assist

2009 Ford sends a car on a 25-state journey, nicknamed the "Mother of All Road Trips," to test collision warning with brake support and other systems



2013 Ford launches fleet of 10 Fusion Hybrid autonomous research vehicles for testing and development

2015 Ford transitions from the research phase of fully autonomous vehicle development to the advanced engineering phase

2015 Ford secures a license to test autonomous vehicles in California and opens its Palo Alto research center

2015 Ford becomes the first automaker to test a fully autonomous vehicle at Mcity

2015 Ford performs the first demonstrated autonomy test in snow

2016 Ford announces it will triple its autonomous test fleet

2004 2005 2006 2007 2008 2009 2013 2015 2016 2021

2021 Ford intends to mass-produce a high-volume, fully autonomous, SAE level 4-capable vehicle for ride-hailing or ride-sharing services

Source: HybridCars

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LiDAR integration – the beginning at FORD

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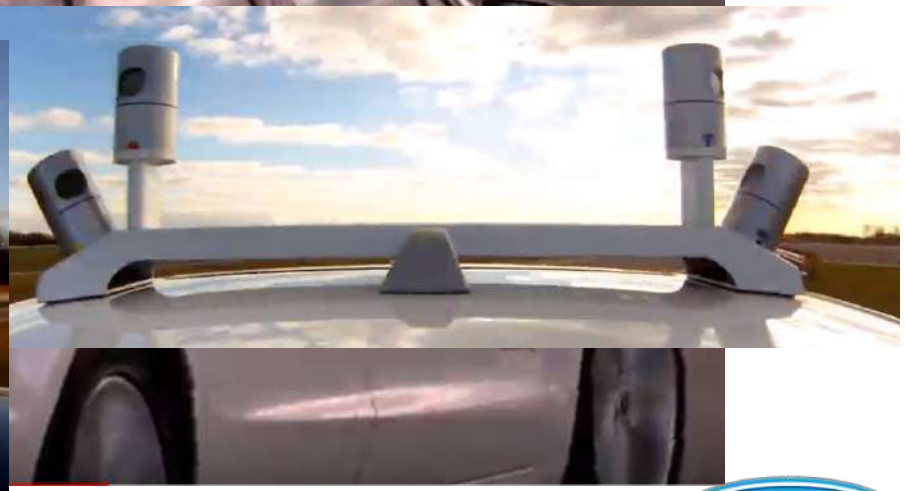
LiDAR integration – evolution

2nd Generation



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LiDAR integration – evolution

Velodyne LiDAR on Ford Fusion/Mondeo demo

2.232 Aufrufe

nwradu
Am 06.03.2014 veröffentlicht

Four HDL-32 LiDAR units mounted on a new Ford Mondeo demonstrate the technology for detecting nearby objects with a good resolution.

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LiDAR integration – evolution

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LiDAR integration – evolution

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LiDAR integration – evolution

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Sensor – Fusion – Lidar & Camera

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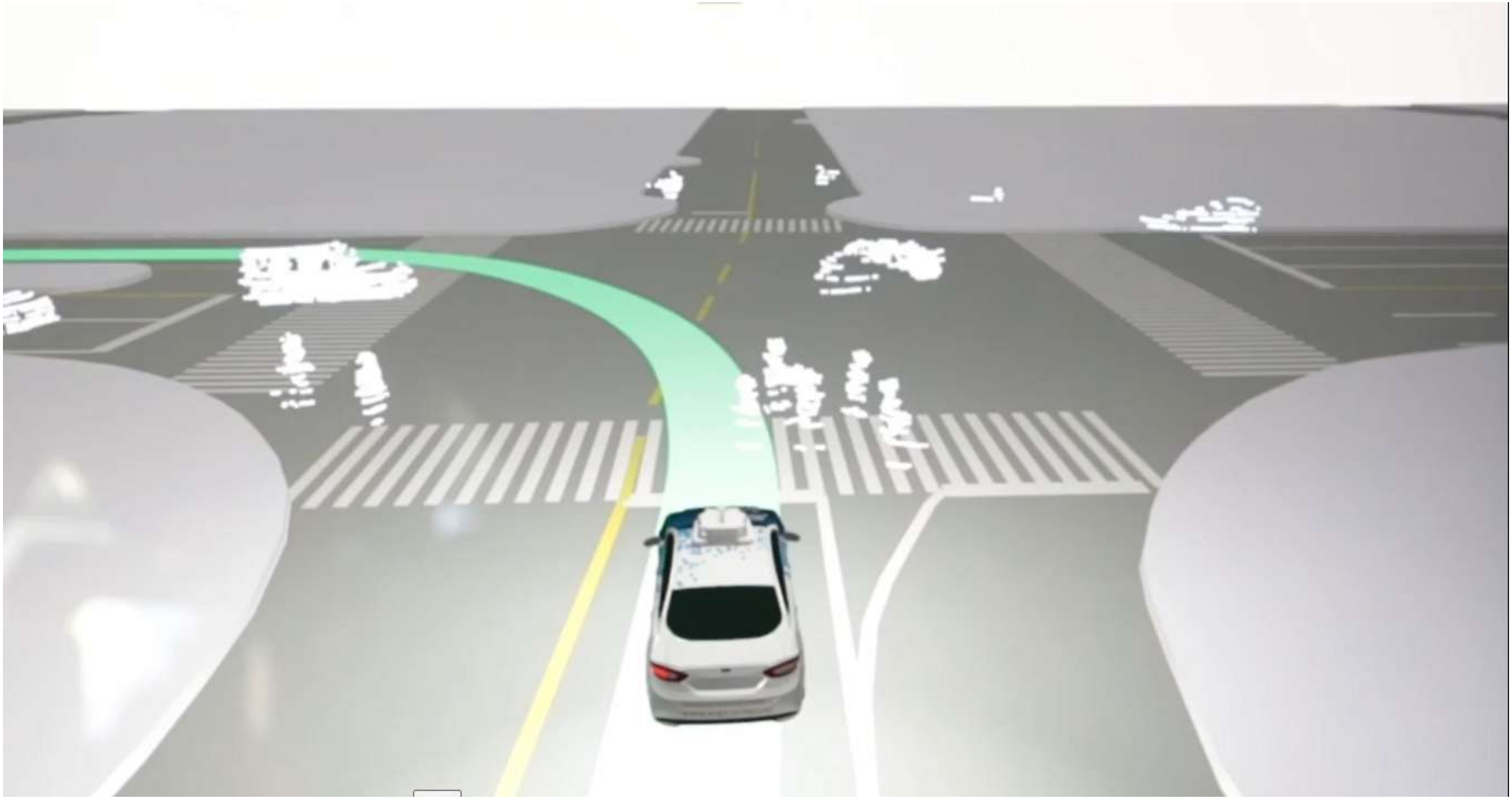
Virtual World and predicted path



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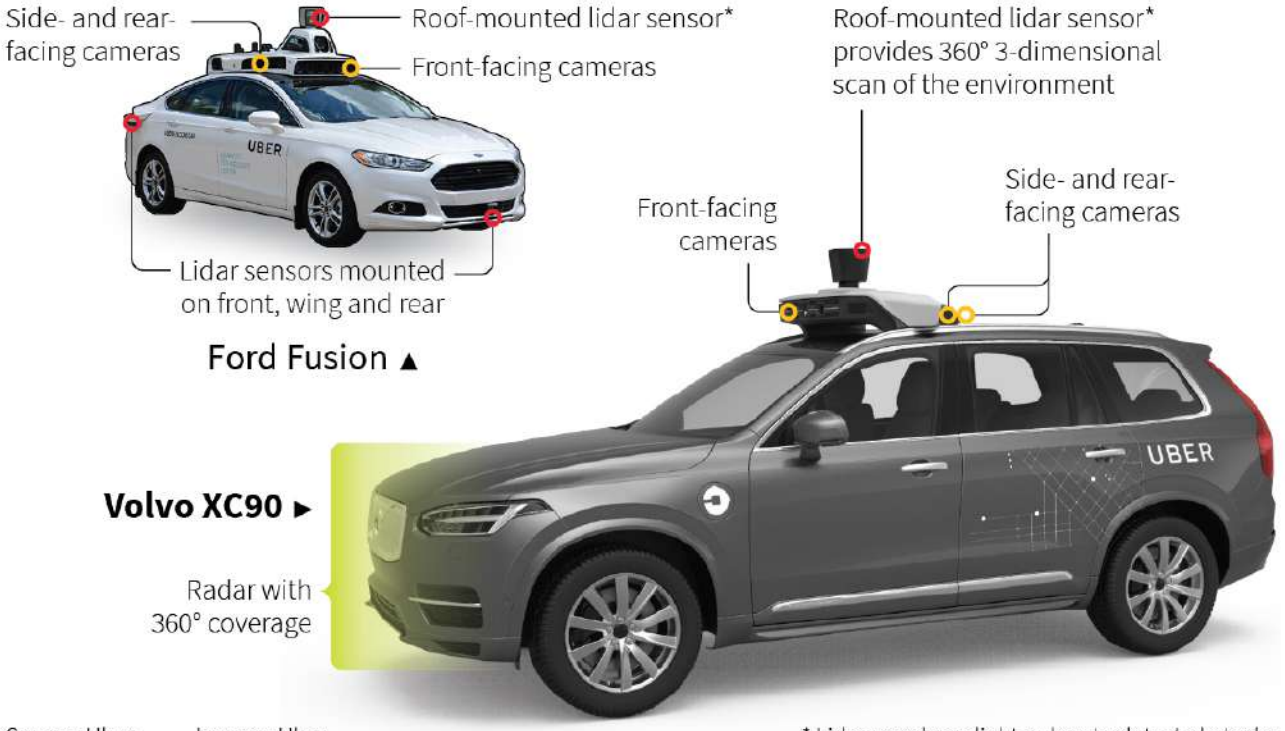
How Uber altered safety sensors on newest test cars

Uber's self-driving Volvo SUV that struck and killed a pedestrian last week in Tempe, Arizona, used fewer safety sensors than the self-driving Ford Fusions that Uber phased out of its test fleet last year.

UBER SELF-DRIVING VEHICLE SAFETY SENSOR SUITE

	LIDAR	RADAR	CAMERA
Volvo XC90	1	10	7
Ford Fusion	7	7	20



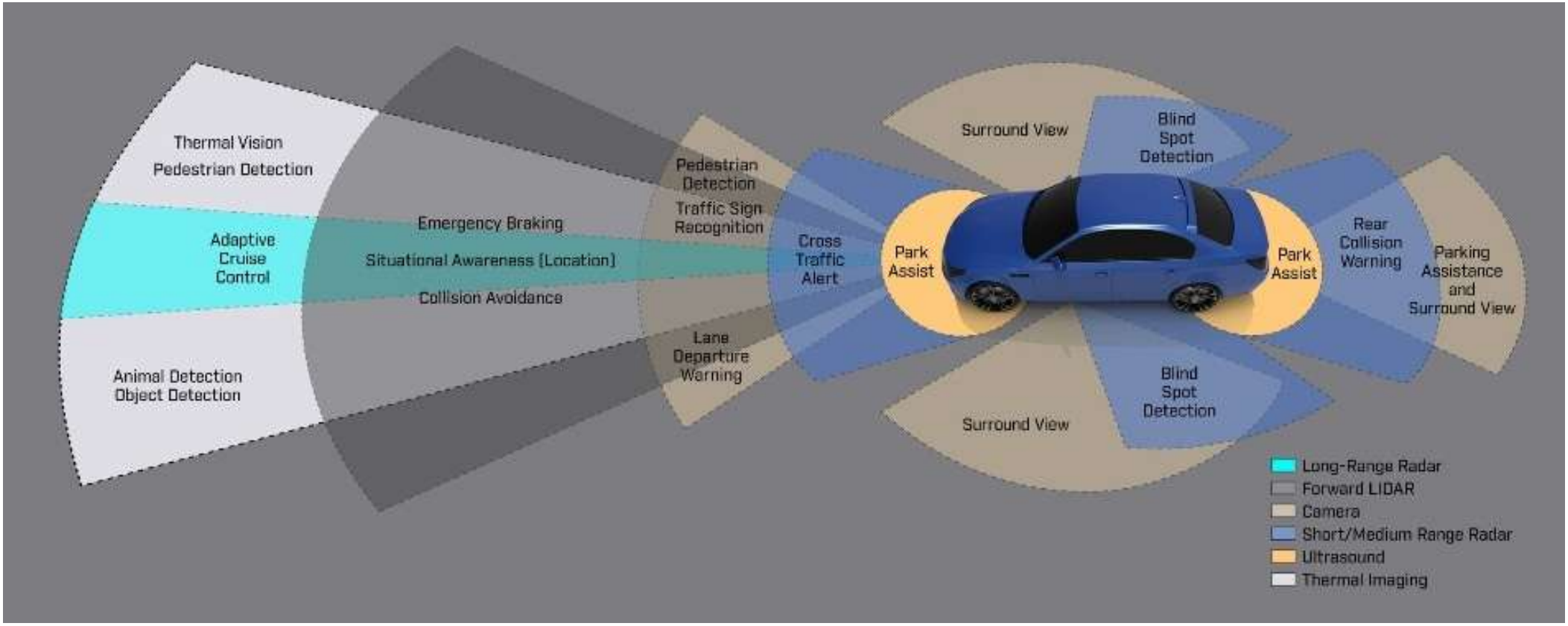
Source: Uber Images: Uber

* Lidar uses laser light pulses to detect obstacles

W. Foo, 28/03/2018

REUTERS

Why 4 different Sensors



Quelle: Flir Sensing

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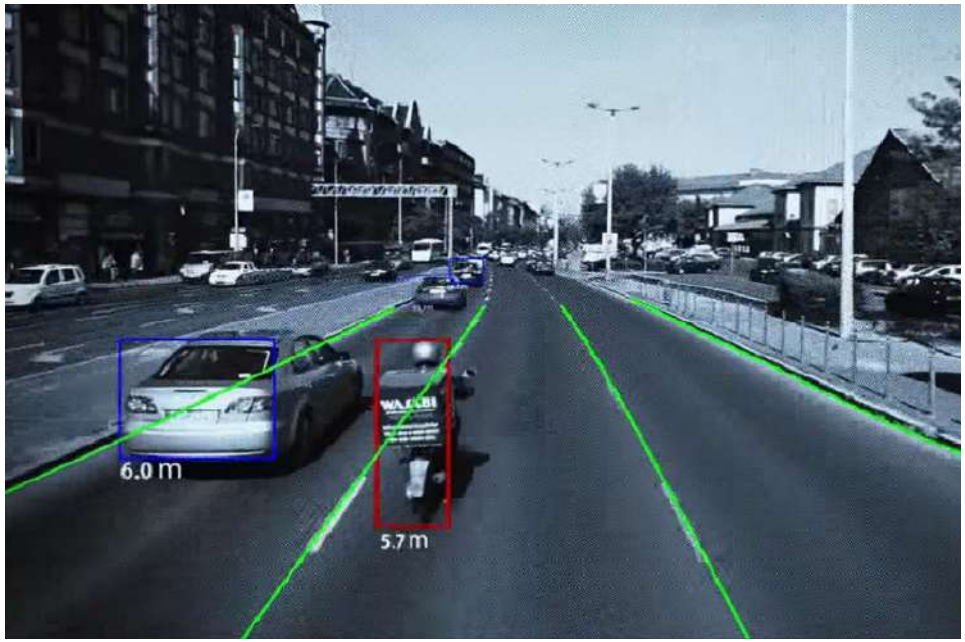
Camera opportunities



- Cameras arrived long time in car industry. Cost efficient
- Precise in color and geometrie detections
- Needs light!

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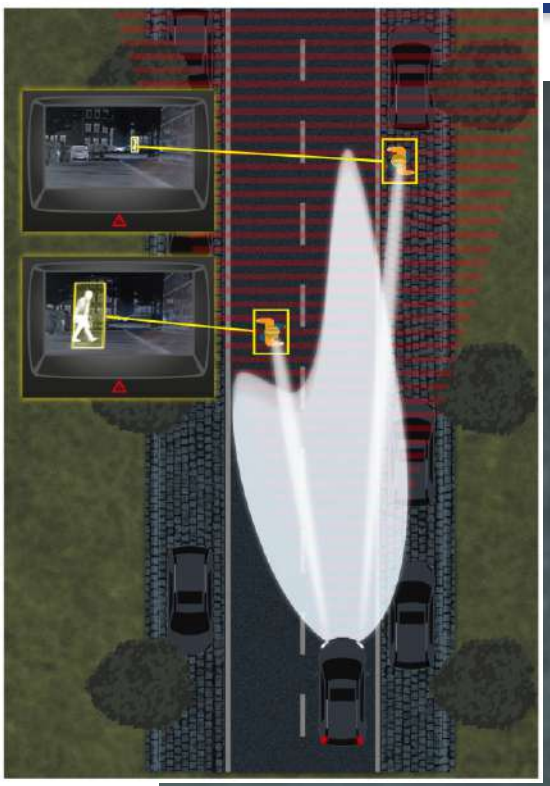
IR Camera opportunities



- Costly, detects warm bodies (living bodies or heated bodies)
- Does require IR emitter for dead geometrie

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IR emitter already in lamps

Quelle: Auto Blog

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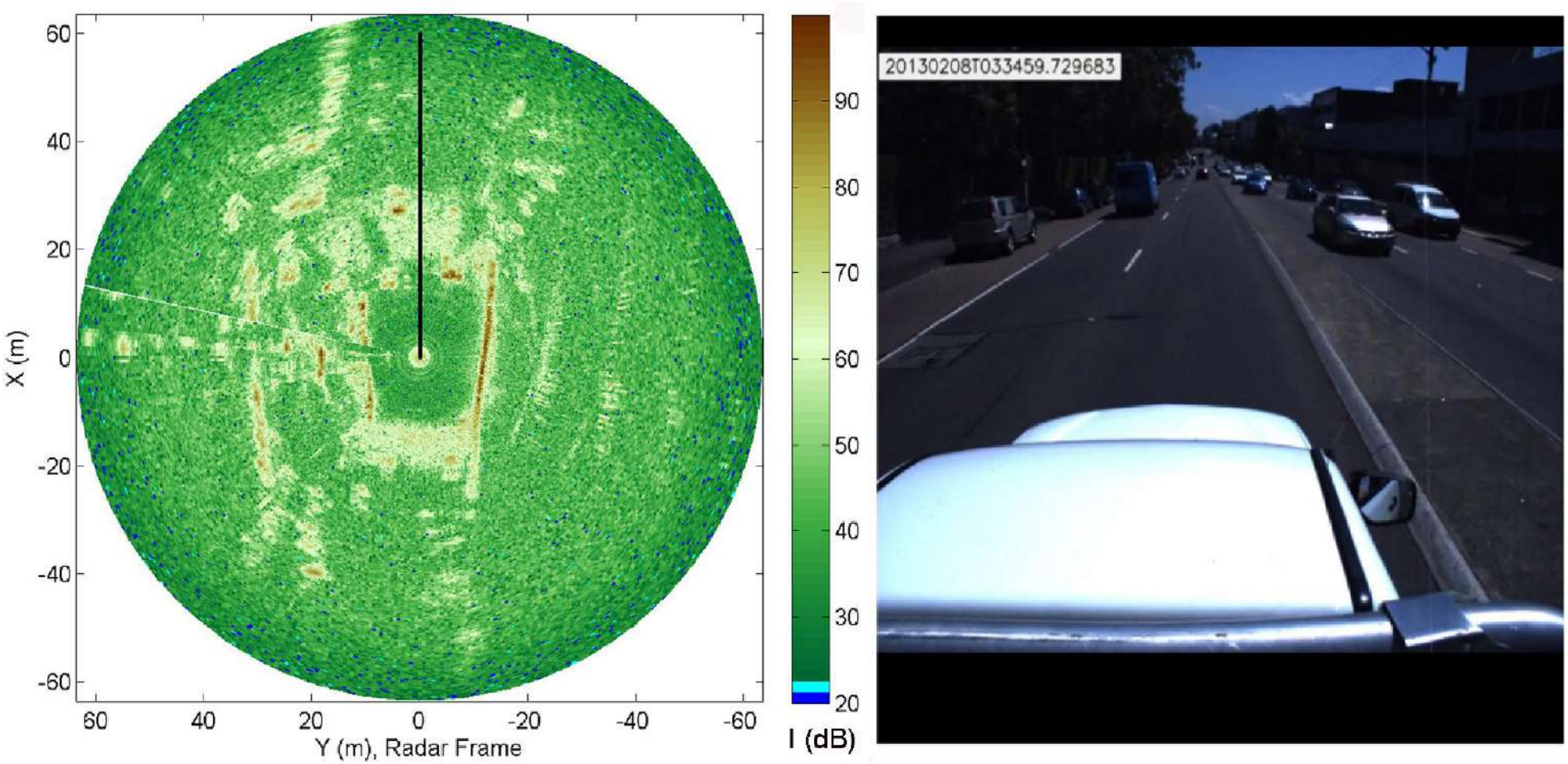
Radar oportunities



- Cost efficient, already arrived in Car industry and integrated in the lamps
- Detection with reduced resolution and accuracy

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Radar already in lamps

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Lidar opportunities

- Costly, size, accurate detection of geometrie
- No color or sign detecion
- Near and far far field capability

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Lidar Supplier and Size overview

LeddarTech
MASTERING LIDAR SENSOR TECHNOLOGY

MAJOR AUTOMOTIVE LIDAR SENSOR PROVIDERS

- Limited number of LiDAR suppliers seeking to meet automotive requirements with distinctive technologies

Valeo
(LeddarTech, Ibeo)

Gen 1 LeddarCore

Velodyne

Quanergy

Continental
(ASCar)

LeddarTech

Gen 2 & 3
LeddarCore

Gen 2 & 3
Leddar
Sensors

Others

Photo Vision
Princeton Lightwave
Scanse
Slamtec
Innoviz
Pioneer

Quelle:LeddarTech Internet

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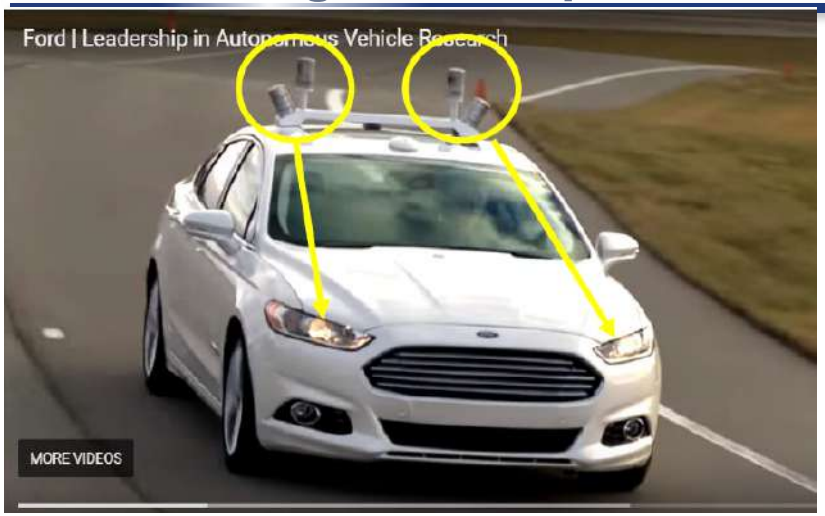
Sensor integration - oportunites



Koito

Magneti Marelli

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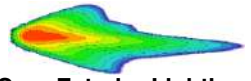
LiDAR integration - challenges



Core Exterior Lighting

- Light fraction at lens:
  fraction dependant on lens shape and surface quality
  design and tooling impact
- Mechanical Lidar: positioning tolerance sensitive (VS SSL)
- High data speed for recognition time needed
- Laser usage and ISO 26262 compliance
- Object detection dependant on lens cleaness
  lens needs to be replaceable or cleaned within mili seconds
- Cleaning and service strategy

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Sensor comparison

Rating: H = High, M=Medium, L = Low	Camera	Radar	LiDAR	Autonomous Requirement
Object Detection	M	H	H	H
Classification	H	M	L	H
Close-Proximity Detection	M	H	L	H
Speed Detection	L	H	M	H
Lane Detection	H	L	L	H
Traffic Sign Recognition	H	L	L	H
Range	H (200m)	H (250m)	M (120m)	Full range
Work in Rain, Fog, Snow	L	H	M	H
Work in Low Light	L	H	H	H
Work in Bright Light	M	H	H	H
Size	Small	Small	Medium	Mix
Cost	$	$$	$$$$	Mix

Quelle: NXP 2017

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Summary and NEEDS

- Lighting supplier need more sensor knowledge to improve
  - Mechanical connection
  - Optical defraction improvements
  - ISO 26262 capabilities

- Regulatory departments need to support the technology progression and enable exterior lighting to provide a maximum value add to drivers and sensors

- Sensor providers need to develop their systems to be less sensitive in:
  - Mechanical fixations and tolerances
  - Cleaningness requirements
  - Object classifications

- Sensors need to shrink and improve detection capabilities

- Avoid redundant sensoring

- Improve sensor fusion……..the best wins

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